

## THE WHITEFISHES

(*Coregonus clupeaformis*)

REARED IN THE NEW YORK AQUARIUM

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*New York Aquarium*

The New York Aquarium is showing a unique exhibit of whitefishes (*Coregonus clupeaformis*) hatched in the Aquarium in January, 1913; unique in that no similar exhibit ever has been seen there or anywhere else. Once or twice whitefishes were reared in the Aquarium to the age of a month, and once to the age of a year; but those now on exhibition—nine years old at the present writing—are the only whitefishes ever reared in captivity from egg to maturity. They are the survivors of a few hundred specimens retained from the fry that hatched out of a consignment of a million eggs received in December, 1912, from the United States Bureau of Fisheries. The eggs came from western Lake Erie waters, and were shipped from the fisheries station at Put-in-Bay, Ohio. The remainder of the fry were distributed to state waters of northern New York and New Jersey.

By checking up our findings with those of other observers, we have learned some interesting facts about whitefishes, the probable age when they arrive at sexual maturity, their longevity, etc. As ours are the only fishes of this species in existence the age of which is positively known, certain biologists engaged in the study of lepidology (the scales of fishes) have been provided with scales from the Aquarium specimens, whitefishes being one of the species in which the age is written in concentric rings on the scales. Of the various kinds of scales in fishes—placoid, ctenoid, cycloid, ganoid or rhomboid, etc.—those which characterize the whitefish are of the cycloid type, *i. e.*, thin, rounded

scales, having concentric rings as just described, and with no spiny projections.

A cycloid scale strongly reminds one of a finger print. It has its central whorl, called the focus, which starts the series of concentric rings, called circuli, and there are lines of radiation called radii. But unlike the finger print, groups of the circuli are marked off in definite dark and light bands, two such bands representing one year of the fish's life. That is, there is a large area of light summer bands and a small area of dark winter bands or annuli, growth being more rapid during the months when temperature is higher and food more abundant.

Dr. Jacob Reighard's assistant in the Department of Zoology, University of Michigan, Mr. John Van Oosten, who is also in the employ of the United States Bureau of Fisheries, made a study of whitefish scales from our Aquarium specimens. One dead fish and three scales from a live fish were sent him each month for twelve months, in order that he might observe progressive changes in the scales of specimens the age of which was known, though it was not to be supposed that fishes that had spent all their lives in captivity, with limited swimming space and little variety in their food, would compare favorably in development with wild fishes. The method followed in removing the scales was suggested by Mr. Van Oosten and consisted in segregating two specimens, removing scales from one fish one month and from the other the next, thus giving each fish a rest of two months between operations. The scales were removed with a small forceps.

Whitefishes are so fragile that they are sometimes killed merely by transference from one tank to another, or by an accidental stroke of the brush when their tank is being cleaned. It was therefore with some trepidation that the writer commenced this series of very delicate operations. The first specimen operated on died within fifteen minutes; but this tragedy was never repeated. All subsequent operations were made on specimens held by the head and tail in a shallow pan of water, the gills being kept continually moist, and great care being taken to remove scales not too near the lateral line (in fact, all scales were removed from a spot about half way between the lateral

line and the back, the section anterior to the dorsal fin being selected) ; also to remove them rapidly and apply a strong solution of permanganate of potassium at once to the injured spot, returning the fish quickly to the tank. The operation always exhausted the fish and it would lie quite still while the permanganate was poured on. When returned to the tank it floated on its back, breathing hard for a few minutes, then gradually equilibrated itself and recovered.

Mr. Van Oosten found that the scales of the Aquarium whitefishes revealed the stunted growth of the specimens in the growth of their circuli, but by experience he gradually learned that by selecting scales of a certain shape, he would obtain scales which showed the annuli or year-rings so clearly that any inexperienced person could read them with ease. In fact, he had various such people read the scales though they knew nothing about the age of the fish from which the scales were taken. He found that while the circuli are formed throughout the year, the annulus is truly a winter-band, being formed only during the winter months, *i. e.*, after October. All of which is explained in detail in his paper here published.

So many of these notable whitefishes died in 1921 that it was imagined they might have lived the natural span of their existence; yet they had never been observed to spawn. It was hinted that they must have done so and the eggs had been eaten so fast that no one ever saw them; but Mr. Robert J. Lanier, of the Aquarium staff, to whom belongs the honor of having reared these fishes, has kept watch over them all their lives and was entirely certain that they had never spawned. Was it possible that captivity prevented them from attaining sexual maturity? If so, the case was a unique one.

In January, 1922, when the fishes were exactly nine years old, females were observed swollen with eggs which, however, lacked vitality to such an extent that they could not be fertilized! Were these whitefishes reaching sexual maturity and their natural span of life at the same time? It seemed impossible.

The writer knew of only one way to solve the riddle. Dr. Wilbert A. Clemens, of the Department of Biology, University of Toronto, who had also received some scales from the Aquarium

specimens, had studied the scales of wild whitefishes. Perhaps he had found some that were older than ours! We wrote him about the eggs, their lack of vitality, the supposition that nine years might be the natural term of the life of the fish, etc., and asked if he had ever found a wild specimen more than nine years old.

His answer, as the following quotation from it shows, was fraught with interest:

"I have indeed taken whitefishes much older than those you have at the Aquarium. I spent last summer on Lake Nipigon and according to my records the largest whitefish we took was twenty-one and a quarter inches in length and was at least sixteen years old. I have records of two others about twenty inches in length, which I have recorded provisionally as sixteen and seventeen years old, but possibly eighteen or nineteen.

"We do not know as yet at what age whitefish first spawn. In Lake Erie I suspect it occurs at the end of the fifth or sixth summer. In Lake Nipigon it probably occurs considerably later. On November 11 of last year I received from the spawn-takers on Lake Nipigon four whitefish which they said were the smallest they had taken spawn from. These were scarcely fifteen inches in length and were nine and ten years of age. So it may be that the whitefish in the Aquarium are just reaching the spawning age, and although the eggs are few and weak this year they may be normal or nearly so next year. It will certainly be interesting to see what happens."<sup>1</sup>

Mr. Van Oosten's paper describes the condition in which he found the sex organs of the Aquarium whitefishes.

This species of whitefish normally attains a length of two feet or more, but none of the specimens in the Aquarium measures more than fifteen inches. We have not infrequently observed that fishes and even snails are stunted by captivity. It is known, however, that fishes do not always stop growing when they reach sexual maturity or decline in years, many continuing to grow as long as they live; and we believe that these whitefishes are still growing, though they probably never will be of normal size.

<sup>1</sup> In December, 1922, when the fishes were nearly ten years old, a female was again observed carrying eggs. She was stripped and the eggs fertilized; but they were weak and did not develop beyond the morula stage.

The last time these specimens were counted was in 1919, when they were transferred from one tank to another and numbered two hundred and sixteen. They have dwindled to about eighty-four, and it is hoped that we may some day be able to repeat the remarkable feat of rearing some to maturity from the eggs—a feat many times attempted both at the Aquarium and at Government hatcheries, but only once performed.

Jordan and Evermann (Fishes of North and Middle America) state that the common whitefish (*Coregonus clupeaformis*) "is subject to considerable variations, dependent on food, waters, etc." The food of fishes is indeed a factor of so great importance in their growth and development that breeders of fancy varieties believe the food controls not only the size and health of the fish, but the actual shape and beauty of its fins. Like other vertebrated animals, they require, for perfect development, foods that are both nourishing and bone-building.

In a state of nature infant whitefishes, judging from those in the Aquarium tanks, remain near the surface for a time, their first food consisting of plankton—live floating matter of both vegetable and animal character: protozoa, diatoms, minute crustaceans such as the young of the shrimp (*Gammarus*) and water fleas (*Cyclops*, *Cypris*, *Daphnia*), etc. Later they subsist entirely on minute crustaceans of these and other species. In the earliest period of their lives, after the absorption of the yolk sac, Dr. S. A. Forbes, of Illinois, has observed that the fry are provided with four curved teeth in the lower jaw, which are of no possible service and are subsequently lost.

Gradually they descend to the bottom for food, and there, according to those who have examined the stomach contents of adult wild specimens, they feed on small live invertebrates, principally crustaceans, snails, insect larvae and water beetles.

The crystalline gray-whiteness of mature whitefishes is exceedingly attractive to the eye, and the specimens in the New York Aquarium have long furnished one of its most pleasing exhibits for the casual visitor, as well as one of its most important economic exhibits for the fish culturist. This species of whitefish is not only the largest, but the most delicate in flavor of all the whitefishes of the Great Lakes.

The Aquarium specimens have never known the excitements of wild life, or what it means to hunt or be hunted.

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